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Geophysical Survey at the Jenkins House Site, 46CB41, located at Greenbottom, Cabell County, West Virginia

By Jonathan P. Kerr and R. Berle Clay

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By
Jonathan P. Kerr and R. Berle Clay

Prepared For:

Huntington District Corps of Engineers
502 Eighth Street
Huntington, West Virginia, 25701

Contact:

Dr. Robert Maslowski
Huntington District Corps of Engineers
502 Eighth Street
Huntington, West Virginia, 25701
Ph. (304) 529-5712

Fax (513)-287-7703

Prepared by:

Cultural Resource Analysts, Inc.
143 Walton Avenue
Lexington, Kentucky 40508
(859) 252-4737 Phone
(859) 254-3747 Fax
Email: jpkerr@crai-ky.com, rbclay@crai-ky.com

R. Berle Clay, Ph.D.
Principal Investigator
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Abstract

From July 10, 2002, through July 2, 2002, Cultural Resource Analysts, Inc. (CRAI), a Lexington, Kentucky firm, completed a geophysical survey of portions of the Jenkins House Site (46Cb41) located in Greenbottom, Cabell County, West Virginia. This survey, prepared for the Huntington District Corps of Engineers, explored the area around the Jenkins mansion where historic features had been previously reported (Hughes and Niquette 1989) together with prehistoric materials. The Jenkins house dates from *circa* 1825-30 and remained in domestic use until the 1980s. It is currently being developed as a West Virginia historical property. The geophysical survey, using two techniques, magnetometry and earth conductivity, identified a number of features and areas where features might be expected. This information will be used to assist conventional archaeological fieldwork planned to locate, identify, and expose historic features relevant to the 19th century Jenkins family occupation. In the following report the two forms of geophysical survey that were used—magnetometry using a fluxgate gradiometer and earth conductivity using an earth conductivity meter—will be discussed by way of an introduction to the surveys and their interpretation. In anticipation, the character and significance of the cultural resources identified by geophysical survey is not fully understood on the basis of this survey alone. Major disturbance has clearly been caused in the 20th century, mainly related to bringing various utilities into--and away from--the house. Still, the geophysical survey does suggest areas of the house vicinity that will be explored by conventional archaeological means.

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Introduction

From July 10, 2002, through July 2, 2002, Cultural Resource Analysts, Inc. (CRAI), a Lexington, Kentucky firm, completed a geophysical survey, using two types of instrumentation, of portions of the Jenkins House Site (46Cb41) located in Greenbottom, Cabell County, West Virginia. This survey, prepared for the Huntington District Corps of Engineers, explored the area around the Jenkins mansion where historic features had been previously reported (Hughes and Niquette 1989) together with prehistoric materials.

The Jenkins homestead was established *circa* 1825-30 and remained in use until the 1980s (Dickinson 1989, Sawrey 1990), although by then it had long since passed out of the Jenkins family primarily as the result of its Confederate sympathies during the Civil War (Dickinson 1989:202-204). In 1825 William A. Jenkins purchased 4,395 acres of possibly undeveloped land (Sawrey 1990:218) along the Ohio River and located his mansion house site on one part of this tract. First, he and his family lived in a wooden structure (location currently unknown): later he constructed the substantial brick house, perhaps by 1830 (Dickinson 1989:195).

A large slave owner when he arrived in Cabell County at Greenbottom, William Jenkins reported 36 slaves in the 1830 Cabell county census (Sawrey 1990:218). By the 1850 agricultural schedule, while presumably still an important slave owner, Jenkins was also clearly a major livestock producer. In that year he reported 29 horses, 20 milk cows (no doubt convertible milk/meat cows), 173 "other" cattle (feeder cattle of various light weights), only 9 head of sheep, but 600 head of swine. For a man who, in early life before he removed to the Ohio River valley, developed shipping in the James River Valley connecting the Tidewater with the Great Valley (Dickinson 1989:194), his farming enterprise, and particularly his livestock, may be seen as a logical extension of his commercial interests on the James River. The extensive farm he purchased at Greenbottom was near to the western terminus of a major livestock-driving trail, which began at Point Pleasant at the mouth of the Great Kanawha and passed through Charleston and Guyandot "where it became (1831) the James River and Kanawha Turnpike" (Henlein 1954:87).

The following survey covers areas around the house built by Jenkins and is a geophysical assessment of a portion of the site. Jonathan P. Kerr, of Cultural Resource Analysts, Inc., performed the survey. It is part of a larger program of archaeological testing at the Jenkins house by CRAI using conventional archaeological excavation, as well as geophysical techniques, to locate and identify features associated with Jenkins' mansion that are suitable for both reconstruction and interpretation to the visiting public. The survey employed both a fluxgate gradiometer--a form of magnetometer--and an earth conductivity meter. This report discusses the nature of this geophysical survey technology, the survey grid and protocol that was used in data collection, and presents the results. A variety of geophysical anomalies were detected, possibly dating from all historic periods of use of the site area, but importantly from the 20th century.

Survey Technologies

The scope of work for the Jenkins house specified geophysical survey with both a fluxgate gradiometer and an earth conductivity meter. Where the cost can be justified, survey with two different instruments has its advantages (Clay 2001; Gaffney et al. 1991:4) because the results tend to be complementary. Field strategy first involved survey with a fluxgate gradiometer because of its speed of operation and general sensitivity to a wide range of archaeological phenomenon. This was followed with the earth conductivity survey covering the same grid.

The fluxgate gradiometer is one of a class of geophysical survey instruments (including proton precession, cesium, and Overhauser magnetometers) known as *magnetometers*. In gradiometer configuration, these are used to perform what are known as *magnetic gradient surveys* (Bevan 1998:18-29). The technology is considered a *passive* survey technology that simply measures the magnetic field at a given point. It stands in contrast to *active* technologies, such as resistivity and conductivity surveys, and ground penetrating radar, which feed an electric or electromagnetic current into the ground and measure its response to soil conditions.

At the latitude of Cabell County, West Virginia, the normal earth's magnetic field measures approximately 50,000 gamma or nanotesla (nT). This is a product of the earth's own magnetic field, diurnal changes in magnetic forces created by solar activity, and local changes caused by a variety of factors including soils and human behavior. In archaeology, only a very small range of the variability in the total, local magnetic field is normally of interest. For example, archaeological features of interest are generally concentrated in a range of *no more than ±20 nanotesla*. In *magnetic gradient* surveys (of the type performed at the Jenkins house), archaeological magnetometers are configured to focus on this very small range of magnetic variation in contrast to the larger, local magnetic effects. A *fluxgate gradiometer* measures the difference in local magnetic effects between two vertically aligned fluxgate *magnetometer* sensors. In a steady state, there is no difference between magnetic readings at the two and the reading is "0." The readings from such an instrument are referred to as "0" mean data. When the magnetic effects below the point of measurement rise, the figure goes up, when they decline, it goes down. At the same time, the effects of all other magnetic forces are generally cancelled out because they equally affect both sensors.

Magnetometers are designed to respond to induced and remnant magnetism in the ground and archaeological features (see von Frese (1984) for an excellent discussion of the nature of anomalies identified by magnetometers). The burning of clays and clayey soils by cultural activities creates an important magnetism of archaeological interest. In the form of prepared, burned hearths, structures destroyed by burning, and artifacts created by firing (for example, pottery and construction bricks), magnetic fields are created at the time of burning; these magnetic fields retain their strength, and register higher levels of nT when measured by a gradiometer. Igneous rocks also exhibit remnant magnetism and soil materials (like magnetite) found in the ground and in iron, where it is described as permanent magnetism. Magnetometers faithfully record the presence of ferrous materials (iron), which are important in the survey of historic period sites.

At the same time, magnetometers record the “rearrangement” of magnetic materials, called magnetic susceptibility, generally concentrated in topsoil. This magnetic susceptibility is a reflection of human occupation, a product of the distribution of midden (von Frese 1984:11). In its classic form, the magnetometer can record when human excavations displace this magnetic susceptibility through excavation and refilling of trenches, ditches, pits, and the like.

Finally, magnetometers respond to the *lack* of magnetism in the soil and its contents. For example, a limestone structure foundation will show a negative magnetic effect in comparison to the soil around it and magnetometers, for this reason, are efficient locators of similar buried foundations. Likewise, stone and gravel roads and paths demonstrate negative magnetism and magnetometers may be used to identify such features.

Magnetic data collecting at the Jenkins house used a FM36 fluxgate gradiometer manufactured by Geoscan Research, an English firm. The instrument, developed in connection with English Heritage, is distinctive in that it has been designed specifically for archaeological use and can be automatically triggered very rapidly (over 8 times per second). Thus, it permits the collection of very dense data sets of local magnetic effects, which are needed for the fine resolution of archaeological features. While its depth sensitivity is in part dependent upon the strength of the magnetic signal, as a general rule, the FM36 is sensitive to geophysical phenomena to a depth of about 1.5 m. Data were downloaded in the field to a laptop computer and processed with the Geoplot 3.0 (Geoscan Research) program. Processing was limited to adjustment of survey rows to counter pacing errors and clipping of the recorded values to eliminate $\pm$ high outliers. The results are presented in the form of gray scale images produced by transferring the results processed in Geoplot to a package known as Didger 3 (Golden Software), then Surfer 8 (Golden Software). In these images, "high" magnetism is indicated by darker color, "low" by lighter color.

Where feasible, it is a generally accepted practice to combine a gradiometer survey with either a resistivity or conductivity survey (also known as electromagnetic or EM survey) because the results are complementary. This is because the two technologies measure different geophysical features and the combined results increase the "dimensions of understanding" in any survey situation (Clay 2001). Conductivity and resistivity are, of course, the reciprocals of each other, and are two ways of looking at the same phenomenon—the ability of the earth to pass an electrical current. They are measured by quite different technologies (Bevan 1998:7-18, 29-43), and as result, one of them (conductivity) is much faster and flexible to use in the field than the other. It is primarily for this reason that Cultural Resource Analysts, Inc. routinely uses conductivity surveys with an EM38 earth conductivity meter (Geonics Ltd.) to complement surveys with the Geoscan Research FM36 fluxgate gradiometer.

At the Jenkins house site the EM38 was carried approximately 15 cm above the ground. Carried in this manner (rather than placed on the ground for each measurement), the EM38 effectively measures mS/m to a depth of approximately 140-50 cm. Following Bevan's suggestion (1998:42), the EM38 was carried in a sheath made of half-inch thick foam insulation to reduce thermal drift. There is no evidence from the results of the limited conductivity survey that the machine suffered from thermal drift, most pronounced as the ambient temperature rises during the course of the day.

Data were recorded in a separate Polycorder 720 data logger. From this, they were downloaded to the computer using the DAT38 (Geonics, Ltd.) data transfer program, transformed first into *.g38 (Geonics specific) files, then XYZ files for export to Geoplot 3.0. X and Y values were then stripped off, and the Z values alone were exported to Geoplot 3.0 respecting the strict file size parameters inherent in Geoplot 3.0. Thereafter, they were treated like FM36 gradiometer files to produce report graphics. In these gray scale graphics, as with the magnetic data, dark indicates high values of mS/m, and light indicates lower values.

Conductivity and resistivity measure the soil conditions irrespective of its magnetic properties. Thus, they measure somewhat different characteristic of the ground than magnetometers (although the ground characteristics can coincide; for example, more magnetic soil can also be more conductive or less resistive). In mound surveys in the South (Clay 2001:39-41), conductivity has been found valuable in determining the extent of mound fill in structures and, in complex mounds, individual mound stages where they have been degraded by agriculture or other activities. In addition, EM survey might reveal structural details of foundations (wall trenches and tamped earth floors) that could not be detected by magnetic survey unless they had been burned.

Use of the EM38 can be complicated by the technology used to measure mS/m, which also registers the presence of *all forms* of metal (ferrous and non-ferrous). In fact, the electronics for measuring conductivity are similar in one aspect to those used in metal detectors. However, while this may limit the usefulness of the EM38 in sites that have been heavily impacted by recent occupation (most importantly urban lots), in dealing with prehistoric sites and historic sites dating from the 19th century and earlier, this is generally not a problem. In the case of historic sites, this may be an advantage of conductivity meters over resistivity survey (which does not measure the presence of *any* metals). Lightning also adversely affects the output of the EM38 as well as and some nearby power lines.

Although the ability of the EM38 to respond to all forms of metal would appear to be a liability in archaeological survey, when used in conjunction with a magnetometer such as the FM36, it has an important and very positive side effect. Notably, the EM38 does not respond to the remnant magnetism in, for example, a burned prehistoric feature like a hearth. Thus, if an anomaly registers in nT but not in mS/m, it could hypothetically be a burned feature and *not* a metal signal. At the same time, where both the magnetometer and the conductivity meter record an anomaly, it is probable that it indicates a ferrous (iron) target. Finally, where conductivity registers a discrete anomaly that is not recorded by the magnetometer, it is possible that it is a non-ferrous target (brass, copper, etc.).

Survey Grid and Survey Protocol

To the north (front) of the Jenkins house the lawn sloped off abruptly to low ground (Figure 1). Survey was carried toward this low ground including the lawn area as delimited by the gateposts to the walk leading to the front door. To the south (back of the house), the lawn sloped off less abruptly and the survey was carried to the break in contour. The accessible areas around the Jenkins house were divided into 20-meter squares that were then individually surveyed with the geophysical instruments. The total grid was oriented with the cardinal directions and was 80 meters long (north/south) and 80 meters wide (east/west): it is the same grid that will be used for further archaeological testing by CRAI (Figure 1) although it is not the same grid used in an earlier evaluation of the National Register status of the property (Hughes and Niquette 1989: Figs. 7, 8, 9). Within it, 4,900 square meters (76% of the larger grid) (.49 hectares or 1.211 acres) were covered in 20-meter and 10-meter squares. The remaining 1,500-square meters (24% of the larger grid) (.15 hectare or .371 acres) were either occupied by the footprint of the Jenkins house itself or its facilities (importantly a steel LP gas tank), or were outside the area of interest in low ground to the north of the house site.

A single protocol was used for the magnetic gradient survey. All squares were surveyed along transects 1 m apart. Along these, readings were taken at 25 cm intervals following a "zigzag" survey pattern (out on one row, back on the next). This survey effort produced 1,600 readings of nT per 20 m square. The gradiometer was automatically triggered and the results stored in the EM38 were downloaded to a laptop computer in the field using Geoplot 3.0 (Geoscan Research).

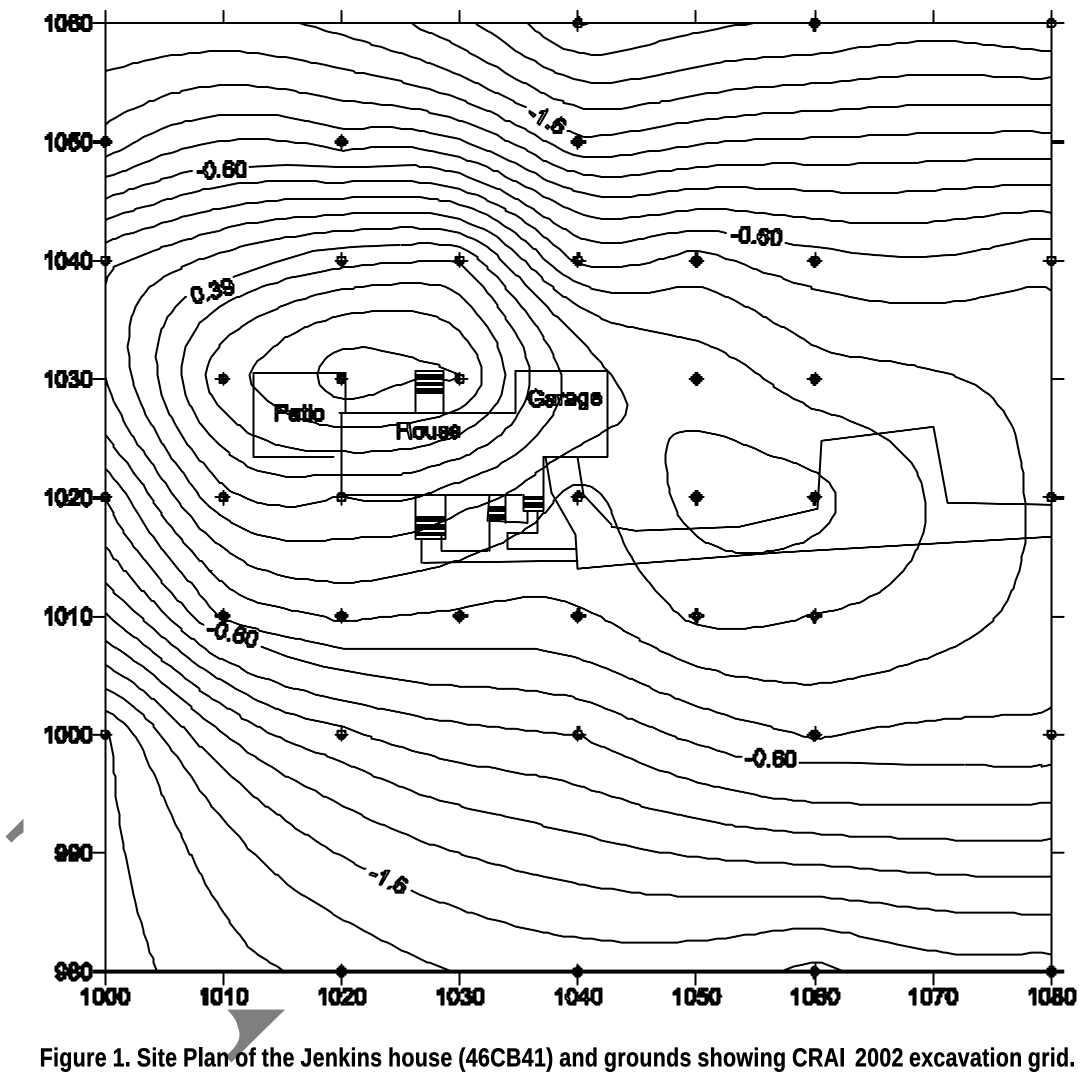

Figure 1. Site Plan of the Jenkins house (46CB41) and grounds showing CRAI 2002 excavation grid.

During the earth conductivity survey were collected with the EM38 over the data same squares that had been initially surveyed with the fluxgate gradiometer. Readings of mS/m (earth conductivity) were collected at 50 cm intervals along transects 1 m apart for a total of 800 readings of mS/m per 20 m square. Because of electronic restraints in the design of the EM38, "a "parallel" survey transect was followed, rather than "zigzag' (all survey was made in one direction only). Data were collected in a Polycorder 720 data recorder that both automatically triggered the EM 38 (one reading per .5 second) and recorded the results. These were then downloaded in the field to a laptop computer using the DAT 38 (Geonics, Ltd.) program.

Introduction to the Results

Any discussion of the geophysical results must be prefaced with a review of results obtained during the initial National Register evaluation of the Jenkins house (Hughes and Niquette 1989). During that earlier study both systematic auguring and hand-excavated units were used to explore the vicinity of the structure (Hughes and Niquette 1989:116-124). As result, a series of observations were made on the reality and possibility of features nearby dating to the Jenkins occupation.

Areas of interest that were identified by shovel probes around the Jenkins house in 1989 are indicated in Figure 2 (these data were collected on a different grid which cannot be reconciled to the grid used in the current investigation of the site). These are based on "items per 10 meter square" which could be classified in Stanley South's "architecture group"(see discussion in Hughes and Niquette 1989:116119) including nails, window glass and brick fragments. Abstracted from Hughes and Niquette 1989: Figure 8, these consisted of concentrations of the architecture group south and east of the house (Areas 1 and 2 in Figure 2) and west to slightly northwest. In addition, there were concentrations of South's "kitchen group" (principally ceramics) off the northeast and west corners of the structure.

Hand-excavated test units east of the house also identified foundations adjacent to the present wood framed addition added to the house in the early 20th century. These consisted of portions of what appeared to be rough cut stone foundation with some brick fragments. These foundations were identified as the "original kitchen" (Hughes and Niquette 1989:140) apparently with little reason for this specific use designation. They mapped this enclosure as a detached dependency off the east end of the main house block. These structural elements fell in an area that could not be surveyed with the geophysical instruments because of the presence of a steel LP gas tank and associated pipes.

Having located these foundation fragments, the excavators in 1989 felt that there may have been a wing or dependency on the *west* end of the main house block balancing what they felt was the kitchen on the east. A very limited excavation in the expected location of this dependency did not reveal portions of the destroyed foundation. This absence was rationalized by the excavators as due to the fact that the stone had been robbed from the foundation trench to build the current patio just off the northwest corned of the house block (Hughes and Niquette 1989:140). It was possible to survey the area of this supposed dependency with both geophysical survey instruments.

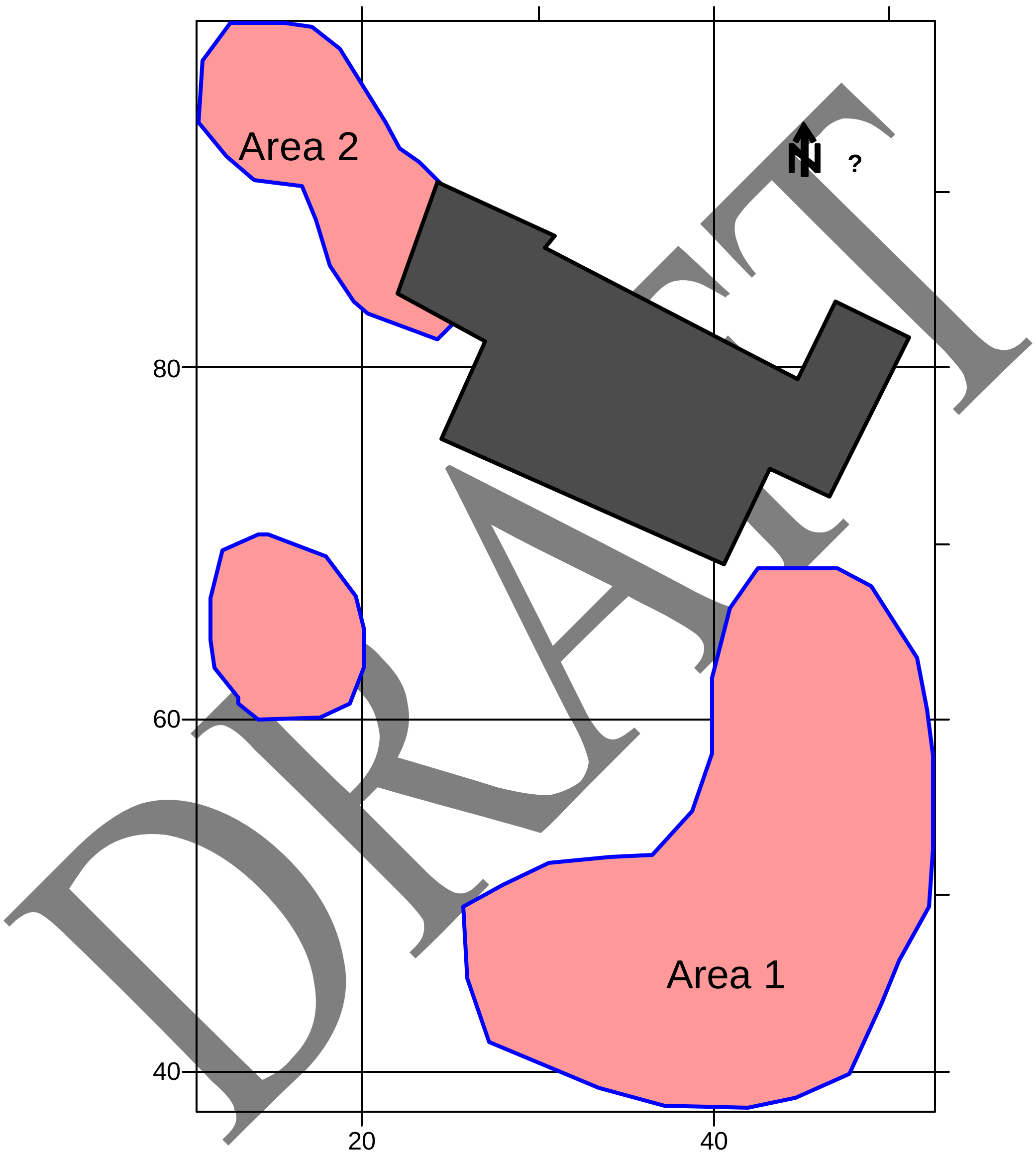

Figure 2. Areas of archaeological interest identified in 1989 (from Hughes and Niquette: Figure 8).

The Magnetic Gradient Survey

The results of the magnetic gradient survey are presented in Figures 3 and 4. Considerable metal was encountered around the house and this is clearly evident in the results. To deal with this, high ± values of nT (above 25 nT and below –25 nt) have been blanked out in Figure 3 to enhance the contrast of those area where there is very low variation in readings of nT. High values of nT are dark, low values are lighter. Blanked out very high/low values are dark green.

Various magnetic features are identified and numbered in Figure 4. Number 1 is a major magnetic anomaly around a power pole reflecting metal brace wires. It is quite recent in date. Number 2 is a major magnetic signal that would seem to be associated with a septic tank/grease trap behind the house, itself linked with a buried metal line, 10, leading down the slope behind the house to lower ground.

Number 4 is a major metal signal, like 3, associated with drainage facilities of the Jenkins house and linked to the house by the line, 9. Number 5 is a gas line leading into the house from the northeast, front of the dwelling. Number 6 is probably an extension of this line that runs parallel to the façade of the structure.

Number 7 appears to be a major metal signal off the northwest corner of the house. It is at least partly "created" by the surveyor in the process of avoiding a large tree at this point (through twisting of the FM36). Interestingly, this signal does not show in the conductivity data although, if metallic, it would be expected. Thus there is at least the possibility that 7 represents brick masonry which would register a magnetic signal but which might not be detected for its unrelated, low conductivity, by the EM38 earth conductivity meter.

Number 8 is a drainage pipe leading away from a downspout on the corner of the Jenkins house. Number 9 is a buried pipe leading off to 4, perhaps a septic tank. Number 10, likewise is a drainage pipe leading away from 2, perhaps similar in function.

Finally, 11 may be a masonry foundation defining the current limits of the "patio." This feature appears to be paved with cut sandstone blocks salvaged from elsewhere around the house. It is just possible that the foundation detected by the magnetic gradient survey is in fact the foundation "stub" of at attached dependency off the northeast corner of the house.

As a general comment, plow scars are evident east of the house reflecting earlier agriculture cultivation, or perhaps in part dating from the archaeological evaluation in the 1980s which involved strip plowing (Hughes and Niquette 1989:29). In addition, the general "magnetically disturbed" around the house (which is a product of seemingly unpatterned changes in nT due to a variety of causes including minor metal) is clearly evident. In it a number of prominent metal signals are identified with red dots. These could represent relatively small targets.

In summary, the magnetic gradient survey has largely identified recent historic features of the Jenkins house, many or most of them perhaps quite recent. Because many of them contain metal, they tend to create magnetic signatures all out of proportion to their actual size. They indicate the difficulties of using a magnetometer near a structure that *has been used in the 20th century*. These magnetic features would not have surrounded the Jenkins house when it was built in the 19th, even as it may have been modified into the late 19th century

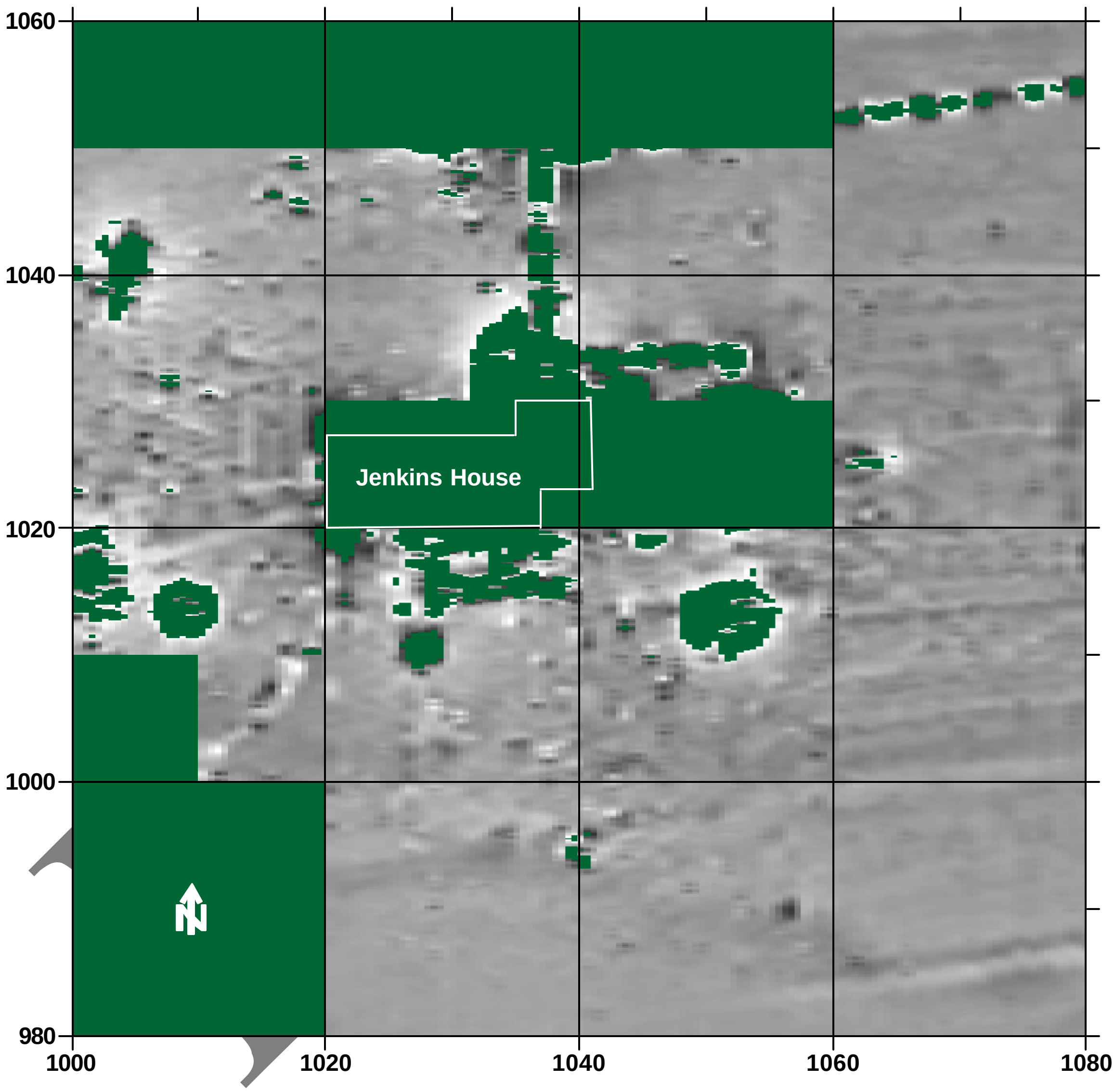

Figure 3. Results of the 2002 magnetic gradient survey of the Jenkins house vicinity.

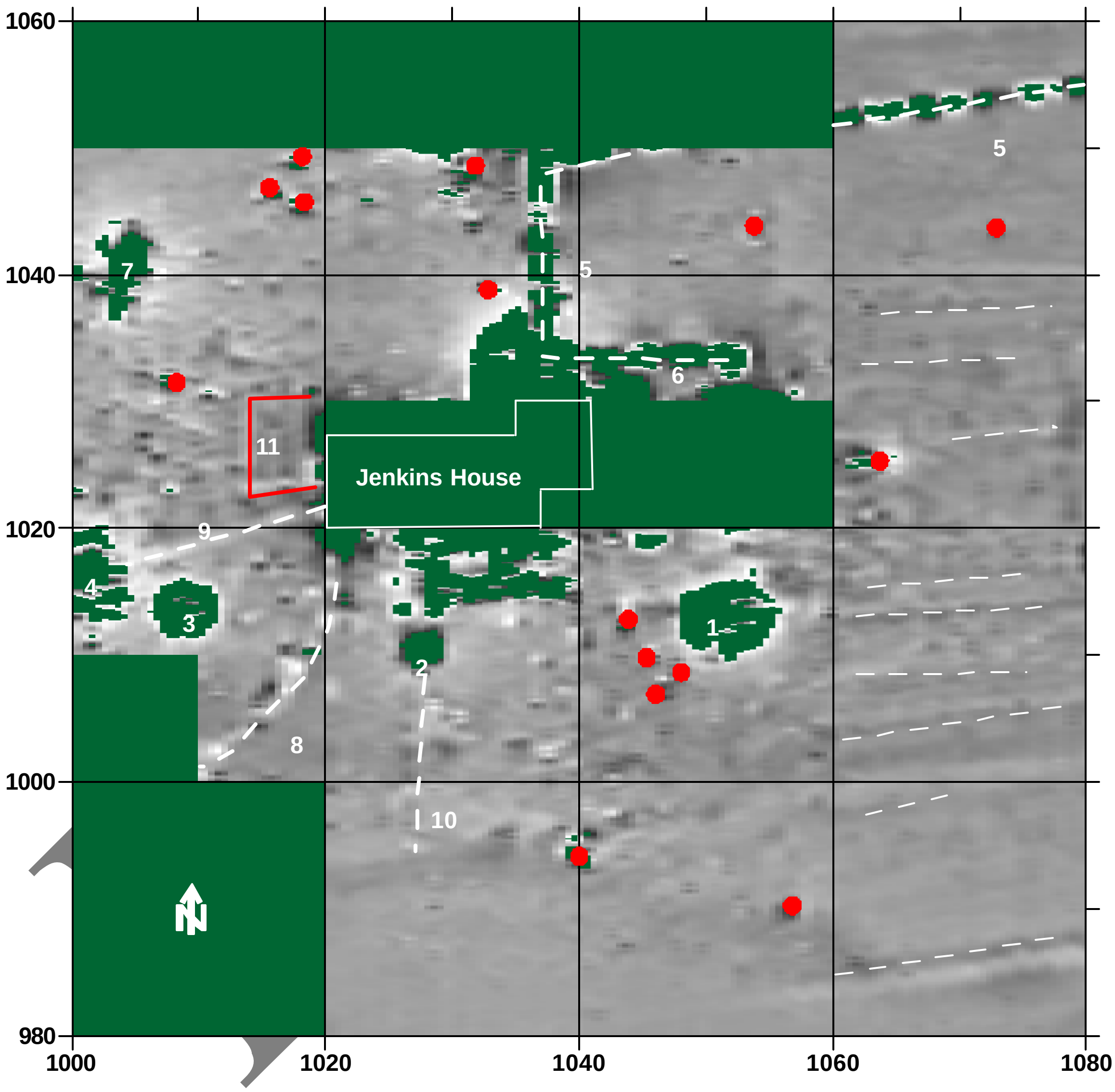

Figure 4. Magnetic areas of interest identified in the magnetic gradient survey.

The Earth Conductivity Survey

The results of the earth conductivity survey are presented in Figures 5 and 6. As in the case of the magnetic gradient survey, high values (in this case of mS/m) are indicated by "darker" areas, lower values by "lighter." Extreme $\pm$ values of mS/m have been clipped to increase the contrast in areas with lower and more meaningful variation. As with the magnetic gradient data, the survey results with the earth conductivity meter are strongly affected by the presence of metal. Most metal signals, indicated by red dots, also register in the magnetic data indicating that they are iron targets of various sizes.

Various conductivity features are identified in Figure 6. These are briefly discussed as follows. Number 1 presents disturbed conductivity (variable but unpatterned variation in mS/m). It is probable that variation in mS/m area reflected architectural debris, for example bricks and stone. Shovel testing during the 1989 evaluation of the site (Hughes and Niquette 1989) also indicated that this was an area of the grounds with a concentration of architectural remains.

Number 2, similarly, may represent an area of concentrated architectural remains. Significant metal targets occur both in 1 and 2, as the do in the magnetic coverage of the same portions of the mansion grounds. At Number 3 the outline of the "patio" is clearly evident. The conductivity data, like the magnetic gradient data, suggests that the perimeter of the patio may be defined by a distinct foundation. In the magnetic gradient data this shows up as somewhat lower in nT than the surrounding soil while in the earth conductivity data it shows up as a linear, low mS/m (lower conductivity) mass.

At Number 4 the gravel car track leading up to the house is clearly evident in the conductivity data, the two, low mS/m tracks reflecting the gravel tracks for the car wheels. A path leading up to the front door of the Jenkins house is reflected at Number 5 in a low mS/m strip. At the northern end it passes between flanking metal anomalies that are the iron, gateposts. The gas line coming onto the property from the northeast is strongly represented by 6 creating a much more pronounced signal than the magnetic gradient data.

The pipe carrying rainwater from the downspout on the southwest corner of the main house is well marked by Number 7 curving off to the southwest. The possible septic tank at Number 8 is also clearly evident. Finally, there is a suggestion of plow scars at Number 9 along the eastern side of the homestead, perhaps dating to the archaeological evaluation of the 1980s or possibly reflecting earlier agricultural cultivation.

Conclusions

By themselves, the magnetic and conductivity data provide little specific information on archaeological features surrounding the Jenkins house. They do provide a rather specific plan of the modifications that have occurred near the house, most of them are probably quite recent, associated with various utilities. As a general rule, the continued updating of a residence into and through the 20th century from whatever simpler 19th century beginnings causes significant changes in the immediate archaeological context. Test excavations in 1989 (Hughes and Niquette 1989) did locate what were apparently sections of stone foundation east of the house in area, which could not be covered with geophysical instruments because of the presence of a steel LP gas tank. These suggest that some intact features may exist.

At the same time the geophysical surveys reported here suggest that the present "patio" is surrounded by a masonry foundation. Given that the flooring of the patio is cut sandstone presumably salvaged from some aspect of the architecture of the house, indicating that parts of it have been

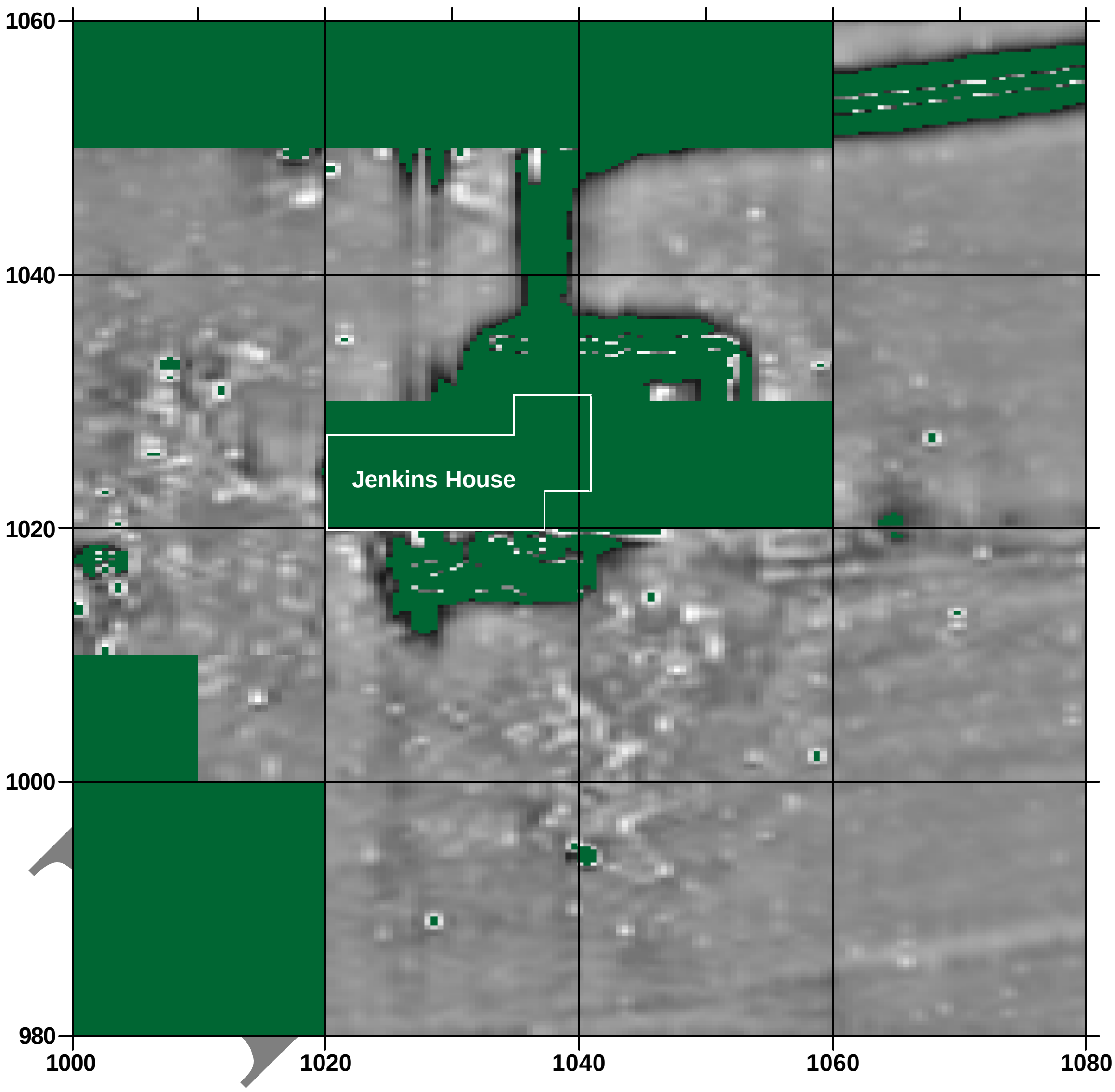

Figure 5. Results of the 2002 earth conductivity survey of the Jenkins house vicinity.

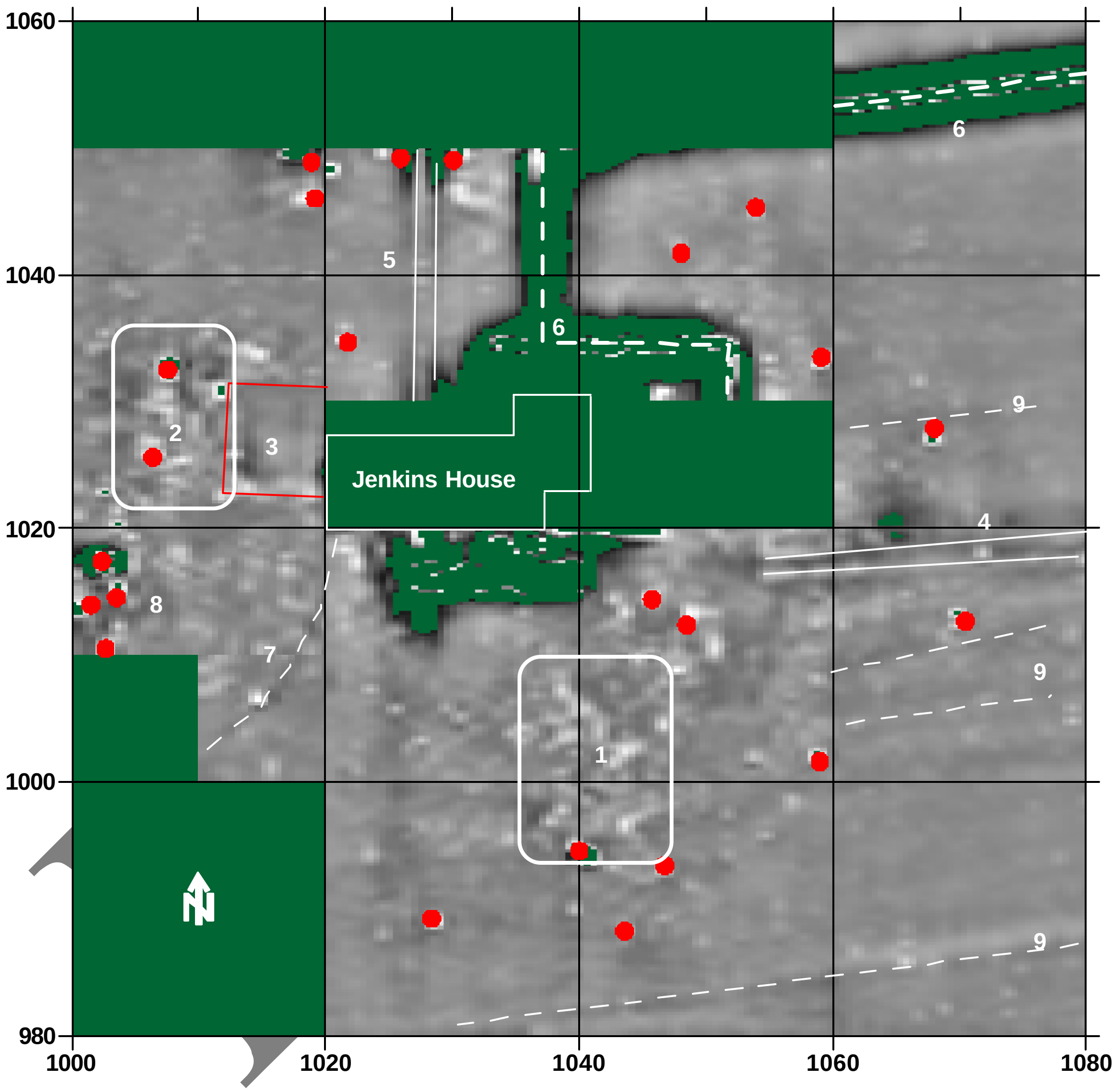

Figure 6. Conductivity areas of interest identified in the conductivity survey.

demolished, it is just possible that the patio may have been built on the footprint of an earlier wing on the northwest corner of the main structure which was slightly advanced to the north beyond the line of the façade of the main structure block. If this is the case, and assuming that the massing of the house was symmetrical, it is also just possible that the present structure on the northeast corner of the main block is built, all or in part, on the footprint of an earlier wing at this location. These questions of architecture and archaeology should both be examined in the course of testing at the Jenkins site.

References

Bevan, Bruce W.
1998 *Geophysical Exploration for Archaeology: An Introduction to Geophysical Exploration*. Midwest Archaeological Center, Report No. 1, Lincoln.

Dickinson, Jack. L.
1989 "An Historical Survey of Greenbottom." In: Myra A. Hughes and Charles M. Niquette, *A National Register Evaluation of the Jenkins House Site and a Phase One Inventory of Archaeological Sites in the Gallipolis Mitigation Site at Greenbottom, Cabell County*, West Virginia. Cultural Resource Analysts, Inc. Contract Publication Series 89-12: 193-207, Lexington, Ky.

Clay, R. Berle
2001 "Complementary Geophysical Survey Techniques: Why Two Ways Are Always Better Than One." *Southeastern Archaeology* 20(1) 31-43.

Gaffney, Chris, John Gater, and Sue Ovenden
1991 "The Use of Geophysical Techniques in Archaeological Evaluations." Institute of Field Archaeologists, *Technical Report No. 9.*

Henlein, Paul C.
1954 "Cattle Driving From the Ohio Country, 1800-1850," *Agricultural History* 28:83-95 (April).

Hughes, Myra A. and Charles M. Niquette
1989 *A National Register Evaluation of the Jenkins House Site and a Phase* One Inventory of Archaeological Sites in the Gallipolis Mitigation Site at Greenbottom, Cabell County, West Virginia. Cultural Resource Analysts, Inc. Contract Publication Series 89-12, Lexington, Ky.

Sawrey, Robert
1990 "Appendix D: Archival Study." In: Myra A. Hughes and Jonathan P. Kerr, *A National Register Evaluation of Selected Archaeological Sites in the Gallipolis Mitigation Site at Greenbottom, Cabell County, West Virginia*." Cultural Resource Analysts, Inc. *Contract Publication* Series 90-08: 211-222, Lexington, Ky.

von Frese, Ralph R. B.
1984 "Archaeomagnetic Anomalies of Midcontinental North American Archaeological Sites," *Historical Archaeology* 18(2) 4-19.